

# Understanding Basic Concept of Electrical and Electronic Systems

Asadullah Shah



IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

# **UNDERSTANDING BASIC CONCEPT OF ELECTRICAL AND ELECTRONIC SYSTEMS**

---

**Editors**

Asadullah Shah



**IIUM Press**

Published by:  
IIUM Press  
International Islamic University of Malaysia  
First Edition, 2011  
©IIUM Press, IIUM

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without any prior written permission of the publisher.

Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

Bibliography p.  
Includes Index  
ISBN

ISBN: 978-967-418-116-1

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM  
(Malaysian Scholarly Publishing Council)

Printed by:  
**IIUM PRINTING SDN. BHD.**  
No. 1, Jalan Industri Batu Caves 1/3  
Taman Perindustrian Batu Caves  
Batu Caves Centre Point  
68100 Batu Caves  
Selangor Darul Ehsan

# CONTENTS

---

<b>DEDICATION.....</b>	<i>iii</i>
<b>PREFACE.....</b>	xiii
<b>ACKNOWLEDGEMENT.....</b>	xiv
<b>1. FAMILIARIZATION WITH MULTIMETER .....</b>	<b>1</b>
1.0 Abstract.....	1
1.1 Introduction.....	1
1.2 Types of Multimeters:.....	2
1.2.1 Digital MMs.....	2
1.2.2 Analog MMs.....	2
1.3 Accuracy .....	3
1.4 Safety Information .....	3
1.5 References:.....	5
<b>2. USING THE MULTIMETER .....</b>	<b>6</b>
2.0 Abstract:.....	6
2.1 Range .....	6
2.2 Automatic Touch Hold Mode .....	7
2.3 Continuity Test.....	10
2.4 Current .....	11
2.5 References:.....	12
<b>3. FAMILIARIZATION WITH OSCILLOSCOPE .....</b>	<b>13</b>
3.0 Abstract.....	13
3.1 Introduction .....	13
3.2 Analog and Digital.....	14
3.3 Types of Waves.....	15
3.4 Sine Waves .....	16
3.5 Square and Rectangular Waves.....	16
3.6 Sawtooth and Triangle Waves .....	17

3.7	References:	17
4.	SIGNALS	18
4.0	Abstract	18
4.1	Step and Pulse Shapes	18
4.2	Waveform Measurements	19
4.3	Frequency and Period	19
4.4	Voltage	20
4.5	Phase	20
4.6	References:	22
5.	PROBES	23
5.0	Abstract	23
5.1	Using Passive Probes	24
5.2	Using Active Probes	26
5.3	Using Current Probes	26
5.4	Where to Clip the Ground Clip	27
5.5	Setting the Controls	27
5.6	References:	28
6.	CONTROL PANEL OF AN OSCILLOSCOPE	29
6.0	Abstract:	29
6.1	Front Panel Control Sections of an Oscilloscope	29
6.2	Vertical Controls	30
6.3	Position and Volts per Division	31
6.4	Bandwidth Limit	32
6.5	Channel Invert	32
6.6	Alternate and Chop Display	32
6.7	References:	33
7.	OPERATION OF AN OSCILLOSCOPE	34
7.0	Abstract:	34
7.1	Math Operations	34

7.2	Display Controls .....	35
7.3	Horizontal Controls.....	35
7.4	Position and Seconds per Division .....	36
7.5	Time Base Selections .....	37
7.6	Trigger Position .....	37
7.7	Magnification .....	38
7.8	XY Mode.....	38
7.9	References: .....	38
8.	MEASUREMENT TECHNIQUES .....	39
8.0	Abstract: .....	39
8.1	Oscilloscopes display .....	39
8.2	Voltage Measurements .....	40
8.3	Time and Frequency Measurements .....	43
8.4	Pulse and Rise Time Measurements.....	44
8.5	Phase Shift Measurements.....	44
8.6	References: .....	46
9.	RESISTOR COLOR CODES .....	47
9.0	Abstract: .....	47
9.1	Introductory Information:.....	47
9.2	First the code .....	47
9.3	The mnemonic .....	48
9.4	How to read the code .....	48
9.4.1	Zero-ohm resistor .....	49
9.4.2	Rheostat .....	50
9.4.3	Potentiometer .....	50
9.5	References: .....	51
10.	SOLDERING IRON PRACTICE.....	52
10.0	Abstract: .....	52
10.1	Introduction: .....	52

10.2	Tools Needed:	53
10.2.1	Soldering Iron	53
10.2.2	The tip of iron	53
10.2.3	Soldering iron stand	54
10.2.4	Solder	54
10.2.5	Solder pump	54
10.3	Safety Precautions:	55
10.4	References:	55
11.	PROCEDURE OF SOLDERING IRON PRACTICE	56
11.0	Abstract:	56
11.1	Handling of soldering iron:	56
1.	Keep the iron in place	58
2.	First, pull the solder away	58
11.2	References:	59
12.	OHM'S LAW	60
12.0	Abstract:	60
12.1	Basic concepts:	60
12.2	Performing experiment of Ohm's law	61
12.3	References:	61
13.	USING THE MULTI-METER FOR OHM'S LAW:	62
13.0	Abstract:	62
13.1	Measuring the voltage across a resistor	62
13.2	Experimental set up	63
13.3	Exercise	64
13.4	References	64
14.	VOLTAGE DIVIDER RULE (VDR)	65
14.0	Abstract:	65
14.1	Basic concepts:	65
14.2	Equipment and materials required are as follows:	65

14.3	Conclusion.....	68
14.4	References: .....	68
15.	<b>COMMON EMITTER AMPLIFIER WITH FIXED BIAS .....</b>	<b>69</b>
15.0	Abstract: .....	69
15.1	Introduction .....	69
15.2	Experimental setup .....	70
15.3	Merits: .....	73
15.4	Demerits: .....	73
15.5	Usage: .....	74
15.6	References: .....	74
16.	<b>COMMON EMITTER AMPLIFIER WITH SELF BIAS.....</b>	<b>75</b>
16.0	Abstract: .....	75
16.1	Basic Circuit: .....	75
16.2	Bias Design: .....	76
16.3	Merits .....	76
16.4	Mathematical Approach .....	77
16.5	References: .....	77
17.	<b>COMMON COLLECTOR TRANSISTOR AMPLIFIER .....</b>	<b>78</b>
17.0	Abstract: .....	78
17.1	Introduction: .....	78
17.2	Parts and equipment: .....	78
17.3	Experimental setup .....	79
17.4	Results and measurements: .....	79
17.5	References: .....	81
18.	<b>DARLINGTON COMMON EMITTER.....</b>	<b>82</b>
18.0	Abstract: .....	82
18.1	Experimental setup: .....	83
18.2	Biasing Design:.....	84
18.3	Design of R1& R2: .....	84



18.4	Tabular column:.....	84
18.5	Calculation: .....	85
18.6	Procedure:.....	85
18.7	Result: .....	86
18.8	References: .....	86
19.	CLASS-A AMPLIFIER .....	87
19.0	Abstract: .....	87
19.1	Apparatus Required .....	87
19.2	Bias design: .....	88
19.3	DESIGN OF R1 & R2: .....	88
19.4	Tabular column:.....	89
19.5	Theory:.....	90
19.6	Procedure:.....	90
19.7	Result: .....	91
19.8	References: .....	91
20.	CLASS – B POWER AMPLIFIER.....	92
20.0	Abstract: .....	92
20.1	Apparatus Required: .....	92
20.2	Theory: .....	93
20.3	Procedure:.....	93
20.4	Tabular column:.....	95
20.5	Formula: .....	96
20.6	Result: .....	96
20.7	References: .....	96
21.	VOLTAGE FOLLOWER.....	97
21.0	Abstract: .....	97
21.1	VOLTAGE FOLLOWER .....	97
21.2	Experiment: .....	98
21.3	Tabular column: .....	99

21.4	Formula: .....	99
21.5	References: .....	100
22.	INVERTING AMPLIFIER .....	101
22.0	Abstract: .....	101
22.1	Inverting amplifier: .....	101
22.2	EXPERIMENT: .....	102
22.3	References: .....	104
23.	SUMMING AMPLIFIER .....	105
23.0	Abstract: .....	105
23.1	Summing amplifier: .....	105
23.2	EXPERIMENT .....	107
23.3	References: .....	107
24.	SUBTRACTOR OR DIFFERENTIAL AMPLIFIER .....	108
24.0	Abstract: .....	108
24.1	Differential amplifier: .....	108
24.2	EXPERIMENT: .....	110
24.3	References: .....	110
25.	INTEGRATOR .....	111
25.0	Abstract: .....	111
25.1	INTEGRATOR .....	111
25.2	EXPERIMENT: .....	114
25.3	References: .....	114
26.	DIFFERENTIATOR .....	115
26.0	Abstract: .....	115
26.1	Description: .....	115
26.2	EXPERIMENT: .....	117
26.3	References: .....	120
27.	COMPARATOR .....	121
27.0	Abstract: .....	121

27.1 Description ..... 121

27.2 References: ..... 122

28. ACTIVE LOW PASS FILTER..... 123

28.0 Abstract: ..... 123

28.1 Description: ..... 123

28.2 References: ..... 128

29. ACTIVE HIGH PASS FILTER..... 129

29.0 Abstract: ..... 129

29.1 Description: ..... 129

29.2 References: ..... 135

30. ACTIVE BAND PASS FILTER..... 136

30.0 Abstract: ..... 136

30.1 Description: ..... 136

30.2 Resonant Frequency ..... 139

30.3 References: ..... 141

# 17. COMMON COLLECTOR TRANSISTOR AMPLIFIER

---

Asadullah Shah and Muniba Shaikh

Department of Computer Science, Kulliyyah of Information and  
Communication Technology,  
International Islamic University of Malaysia,  
Malaysia

## **17.0 Abstract:**

Transistor can be used as an amplifier with its common base, emitter and collector.

Many factors can influence upon the common collector amplifier. Therefore it is important to know these factors that influence its voltage gain.

## **17.1 Introduction:**

The Common–Collector Amplifier often referred to as an Emitter–Follower, is characterized by application of the Amplifier input signal to the Base lead while its output is taken from the Emitter lead. The output signal is never larger than the input but is always in-phase with the input. The output follows the input. The main advantage is that the input impedance of a Common–Collector Amplifier is generally much higher than for other bipolar transistor circuits.

## **17.2 Parts and equipment:**